CLAIMS

1. An electronically commutated motor comprising

a stator, a rotor (39), and a program-controlled microprocessor or microcontroller (11), hereinafter called a microprocessor, serving to control commutation of the motor;

an apparatus for sensing a time variable (t_H) that is substantially inversely proportional to the rotation speed of the rotor (39);

an apparatus for calculating a time (t_TI) dependent on that time variable (t_H);

an apparatus for triggering a motor control interrupt routine (FIG. 10) at a time offset (t_TI) from a predefined rotor position, that offset corresponding to the time (t_TI) dependent on the sensed time variable (t_H);

wherein the motor control interrupt routine contains program steps (S310, S318, S320, S322) for effecting a commutation of the motor.

2. The motor according to claim 1, wherein

the motor control interrupt routine (FIG. 10) contains program steps (S304, S306) which prevent a commutation from being effected if the time (t_TI) dependent on the sensed time variable is greater than a time span (t_H) presently required by the rotor (39) to travel through a predefined angular distance.

3. The motor according to claim 2, having an apparatus which triggers a rotor position-dependent interrupt routine (FIG. 8) at predefined rotor positions.

4. The motor according to claim 3, wherein

a timer (CNT_HL), controllable by the rotor position-dependent interrupt routines (FIG. 8), is provided, in order to sense the time variable that is substantially inversely proportional to the rotation speed of the rotor.

5. The motor according to claim 4, wherein

the timer (CNT_HL) is also configured to trigger a motor control interrupt routine (FIG. 10).

6. The motor according to claim 5, wherein

the timer (CNT_HL) is loadable, during a rotor position-dependent interrupt (FIG. 8), with a first predefined count value (t_B) which corresponds to the time offset (t_TI) dependent on the sensed time variable (t_H);

and which brings about a motor control interrupt (FIG. 10) after counting that first predefined count value.

7. The motor according to any of the foregoing claims, wherein

a rotor position-dependent interrupt (FIG. 8) has a higher priority than a motor control interrupt (FIG. 10).

8. The motor according to any of claims 4 through 7, wherein

the timer (CNT_HL) is loadable, during a motor control interrupt (FIG. 10: S302), with a predefined count value (t_AR);

and subsequent to that loading operation a count is performed until the next rotor position-dependent interrupt (FIG. 8), so as to ascertain, by taking the difference between the predefined count value (t_AR) and the counter status (t_E) upon reaching the next rotor position-dependent interrupt (FIG. 8), a time offset (FIG. 7A: t_1) between these interrupt operations.

9. The motor according to claim 8, wherein an autoreload register (AR), which stores the first predefined count value (t_TI) and feeds it to the timer (CNT_HL) during the motor control interrupt (FIG. 10) as the predefined count value, is provided for loading the predefined count value (t_AR).

10. A method for rotation speed-dependent commutation of an electronically commutated motor which has a stator and a rotor and also a program-controlled microprocessor or microcontroller, hereinafter called a microprocessor, serving to control its commutation, comprising the following steps:

a) a time variable (t_H) that is substantially inversely proportional to the rotation speed of the rotor is ascertained;

b) from that time variable (t_H), a numerical value (t_TI) is calculated according to a predefined calculation rule;

c) beginning at a predefined first rotor position, a first time corresponding to that calculated numerical value is measured;

d) after that first time has elapsed, a commutation (TN) is triggered;

e) subsequent thereto, a second time (t_1) until reaching a predefined second rotor position is measured;

f) the first and second times are added, and their sum, optionally corrected by means of at least one correction factor, is used as a time variable (t_H) that is substantially inversely proportional to the rotation speed of the motor.

11. The method according to claim 10, wherein the predefined calculation rule comprises a subtraction step in which a predefined time (t_ZW) is subtracted from the time variable (t_H) that is substantially inversely proportional to the rotation speed of the rotor.

12. The method according to claim 10 or 11, wherein

when the first time corresponding to the calculated numerical value (t_TI) is greater than the time offset between the predefined first rotor position and the predefined second rotor position, the time offset between those two rotor positions is sensed directly and is used (S256) as a time variable (t_H) that is substantially inversely proportional to the rotation speed of the motor.

13. The method according to any of claims 10 through 12, wherein the time variable (t_H) that is substantially inversely proportional to the rotation speed of the motor is compared to a predefined value (t_SZW) corresponding to a minimum rotation speed (FIG. 9: S264);

a logical value (SZW) corresponding to the comparison result is buffered (FIG. 9: S266); and

if that logical value (SZW) has a predefined value, the triggering of a commutation that is accomplished after the first time (t_TI) has elapsed is suppressed (FIG. 10: S304, S306).

14. The method according to any of claims 10 through 13, wherein when a predefined rotor position is reached, a rotor position-dependent interrupt is executed with an interrupt routine (FIG. 8A, 8B) at the beginning of which a timer (CNT_HL) providing time measurement is halted (S202), and its instantaneous value is stored in a variable (t_E).

15. The method according to claim 14, wherein

in the rotor position-dependent interrupt routine, the timer (CNT_HL) providing time measurement is loaded, after it is halted (S202), with a numerical value (t_TI) previously calculated in accordance with the predefined calculation rule, and is then started (FIG. 8B: S238).

16. The method according to claim 14 and 15, wherein the time span between the halting of the timer (CNT_HL) providing time measurement and the starting thereof is used as a correction factor (t_CORR) when the time variable (t_H) that is substantially inversely proportional to the rotation speed of the motor is ascertained.

17. The method according to any of claims 10 through 16, wherein

the first time corresponding to the calculated numerical value (t_TI), which is measured from a predefined first rotor position, is calculated from a time variable that is substantially inversely proportional to the rotation speed of the rotor and that was ascertained approximately one rotor revolution prior to the instant at which the present measurement of the first time is being made (FIG. 18: 542, 544, 546).

18. The method according to any of claims 10 through 17, wherein

at least one non-time-critical process step is configured as a subroutine (FIG. 9) which is invoked in the program sequence when processor time is available (FIG. 15).

19. The method according to claim 18, wherein calculation of the time variable (t_H) that is substantially inversely proportional to the rotation speed of the motor, and calculation of the numerical value (t_TI) on which measurement of the first time is based, are accomplished in such a subroutine

(FIG. 9).

20. The method according to any of claims 10 through 19, wherein at least one parameter (t_ZW) necessary for calculations is loaded, from a nonvolatile memory (26) associated with the motor, into a RAM (25) of the microprocessor (11).

21. The method according to claim 20, wherein the nonvolatile memory (26) has associated with it a bus (30) by way of which at least one parameter in the nonvolatile memory (26) is modifiable.

22. An electronically commutated motor comprising a stator, a rotor (39), and a program-controlled microprocessor or microcontroller (11), hereinafter called a microprocessor, serving to control commutation of the motor (M),

a timer (CNT_HL) being started with a predefined start value (t_TI) at at least one predefined rotor position, said timer (CNT_HL), after a time dependent on the start value (t_TI) has elapsed, triggering an interrupt (FIG. 10) in the program of the microprocessor (11) during which a commutation (FIG. 10: S318, S320, S322) of the motor (M) is accomplished.

23. The motor according to claim 22, wherein the start value (t_TI) of the timer (CNT_HL) is a function of a rotation speed-dependent time (t_H) which the rotor (39) has required, in a time region preceding that commutation, to rotate through a predefined rotation angle.

24. The motor according to claim 23, wherein, in order to calculate the start value (t_TI), a predefined time (t_ZW) is subtracted from the rotation speed-dependent time (t H).

25. A method for determining a rotation speed-dependent variable in an electronically commutated motor (M) which includes a stator, a permanent-magnet rotor (39), a galvanomagnetic sensor (40) controlled by that rotor, a microprocessor or microcontroller (11) hereinafter called a microprocessor, a control program associated with that microprocessor, and a timer (CNT_HL), comprising the following steps:

a) the output signal of the galvanomagnetic sensor (40) is converted into a square-wave signal (HALL);

b) predefined signal changes of the square-wave signal (HALL) are sensed by the microprocessor and each converted by the control program into a rotor position-dependent interrupt (FIG. 4: Y);

c) at a rotor position-dependent interrupt (Y), a first counter status (FIG. 4: t_0) of the timer is recorded;

d) at a rotor position-dependent interrupt (Y) subsequent thereto, a second counter status (t_E) of the timer is recorded;

e) a value (FIG. 4: HL) which corresponds to the time required by the rotor (39) to travel through a predefined rotation angle (FIG. 4, FIG. 20) is ascertained, as a rotation speed-dependent variable, from the difference between the two counter statuses (t_0, t_E).

26. An electronically commutated motor (M) comprising

a stator (38) and a rotor (39),

a program-controlled microprocessor or microcontroller (11), hereinafter called a microprocessor, for controlling the commutation of the motor (M); and

a rotor position sensor (40, 41) whose output signal is conveyed, for the purpose of analysis by the microprocessor (11), to an interrupt-capable input of that microprocessor and is processed therein;

in order to furnish, at at least one output of the microprocessor, a control signal (OUT1, OUT2), for commutation of the motor, that is shifted by a shift time, with respect to the signal of the rotor position sensor (40,

41), the duration of the shift time being a predefined function of the rotation speed.

27. The electronically commutated motor (M) according to claim 26, wherein the microcontroller (11) comprises at least one interrupt-capable timer (CNT_HL) with which the at least one output of the microprocessor serving to deliver the control signal is influenced.

28. The electronically commutated motor (M) according to claim 27, wherein the timer (CNT_HL) is, in a specific state, automatically reloaded with a value (t_AR) and started again.

29. The electronically commutated motor (M) according to claim 26 or 27, wherein the microprocessor triggers an interrupt at each change in the signal (HALL) of the rotor position sensor (40, 41); and wherein the timer (CNT_HL) and the interrupts are used to measure the HALL length (HL).